

R E M A R K S

Claims 1 to 11 as set forth in Appendix II of this paper are now pending in this case. Claims 1, 4, 7 and 8 have been amended, and Claim 11 has been added, as indicated in the Listing of Claims set forth in Appendix I of this paper.

Accordingly, Claim 1 has been amended to correct a typographical error which occurred in the copy of claims appended to applicants' preliminary amendment. Claim 7 has been revised to remove the reference to the preferred catalyst, and the respective subject matter has been made the subject matter of new Claim 11. Additionally, Claims 4, 7 and 8 have been revised to better bring out the stage of the process of Claim 1 to which the respective dependent claim relates. No new matter has been added.

Favorable reconsideration of the Examiner's rejection of Claim 7, and withdrawal of said rejection, is respectfully solicited in light of the foregoing and the attached.

The Examiner has rejected Claim 1 under Section 112, ¶1. More particularly, the Examiner asserts that the essential requirement that the temperature does not increase along the reactor cascade which is used to conduct the esterification reaction according to stage (a) of applicants' process is not included in Claims 8 and 9.

It is respectfully noted that Claim 8 as well as Claim 9 directly depend upon Claim 1 and incorporate all of the requirements which are specified in Claim 1 by reference, including the requirement set forth in Claim 1 that "the temperature does not increase along the reactor cascade in stage a)". Accordingly, the Examiner's position that Claims 8 and 9 fail to include an essential or critical feature of applicants' invention is not deemed to be well taken.

Additionally, the Examiner asserts that the subject matter defined in Claims 4, 8 and 9 renders the independent and the dependent claims inconsistent. It is respectfully submitted that

- Claim 4 specifically refers to the temperature which is applied in the esterification stage (a);
- Claim 8 specifically refers to conditions which are applied in the pre-condensation stage (b); and

- Claim 9 specifically refers to conditions which are applied in the polycondensation stage (c).

Since the particular embodiments of applicants' process of Claim 1 which are defined in dependent Claims 4, 8 and 9 relate to different stages of the process, and since all of the dependent claims incorporate the requirements of Claim 1 by reference, there is no inconsistency between the independent claim and the dependent claims. Favorable reconsideration of the Examiner's position and withdrawal of the rejection under 35 U.S.C. §112, ¶1, is respectfully solicited.

The Examiner has rejected Claims 1 to 5 and 7 to 10 under 35 U.S.C. §102(b) as being anticipated by the disclosure of **Braune** (US 5,854,377).

As acknowledged by the Examiner in the context of the rejection under Section 112, ¶1, one of the critical and essential features of applicants' process resides in the requirement that the esterification stage (a) is conducted in a reactor cascade comprising at least two reactors where the temperature does not increase along the reactor cascade in stage (a).

In accordance with the teaching of **Braune** the esterification reaction is "carried out in at least two, preferably at least three, temperature zones" and the "temperature of a subsequent zone should be 1°-40°C, preferably 2°-30°C, in particular 5°-10°C, higher than the temperature of the preceding zone" (col. 1, indicated lines 62 to 67, of US 5,854,377, *emphasis added*). The teaching of **Braune** clearly requires that the temperature increases along the reactor cascade which is used for the esterification stage, whereas -in accordance with applicants' process- the temperature does not increase along the requisite reactor cascade. Applicants' process is therefore clearly distinguished from the process disclosed by **Braune**.

To constitute anticipation, all material elements of the invention as claimed must be found in one prior art source<sup>1</sup>). The teaching of **Braune** fails to disclose the material elements or features of applicants' invention. It is therefore respectfully urged that the rejection under 35 U.S.C. §102(b) be withdrawn. Favorable action is solicited.

The Examiner has rejected Claim 7 under 35 U.S.C. §103(a) as being unpatentable in light of the disclosure of **Braun** (US 5,854,377).

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1) ie. In re Marshall 577 F.2d 301, 198 USPQ 344 (CCPA 1978); In re Kalm 378 F.2d 959, 154 USPQ 10 (CCPA 1967)

Claim 7 is dependent upon Claim 1 and therefore, equally, requires that the temperature applied in the reactor cascade of the esterification stage (a) does not increase. Additionally, Claim 7 specifies that the esterification stage (a) is conducted in the presence of a catalyst.

**Braune** teaches that it is necessary to increase the temperature along the reactor cascade which is used for the esterification stage in order to obtain a polyester having a low number of carboxyl end groups (col. 1, indicated lines 62 to 67, in conjunction with col. 1, indicated lines 54 to 56, of US 5,854,377). Applicants have found that a polyester having a low number of carboxyl end groups can also be obtained when the temperature does not increase along the reactor cascade which is used for the esterification stage (a) (ie. page 2, indicated line 27, to page 3, indicated line 2, of the application). Nothing in the teaching of **Braune** suggest or implies that the particular result may be achieved by means other than increasing the temperature along the esterification reactor cascade. The mere fact that the prior art can be modified in some manner so as to arrive at a claimed invention does not support a conclusion of obviousness unless the prior art suggests the desirability of the specific modification which is required<sup>2</sup>). The teaching of **Braune** therefore cannot be deemed to render applicants' process prima facie obvious within the meaning of 35 U.S.C. §103(a).

Furthermore, the particular requirement of applicants' invention that the temperature applied in the esterification stage does not increase along the reactor cascade in which the esterification is conducted results in a reduced formation of THF and 2,5-DHF<sup>3</sup>) by-products which constitutes a distinct advantage of applicants' process compared to the process disclosed in the prior art. The respective advantage becomes apparent when the data set forth in applicants' Table 1, pages 11 and 12 of the application, are reviewed. Examples 1 to 6 (cols. 2 to 7 of Table 1) were conducted applying the conditions which are required in accordance with applicants' invention, whereas in the first comparative example (designated "Comp. 1", col. 8 of Table 1) the temperature in the esterification reactor<sup>4</sup>) cascade was increased corresponding to the teaching of **Braune**. Under the conditions of ap-

2) ie. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (CAFC 1984); see also, eg., Interconnect. Planning Corp. v. Feil, 774 F.2d 1132, 227 USPQ 543 (CAFC 1985)

3) Tetrahydrofuran and 2,5-dihydrofuran, respectively.

4) Temperatures T1 to T3, page 11, rows 8 to 10, of Table 1.

plicants' process, THF<sup>5)</sup> is formed in amounts ranging from 2.01% (Example 5) to 2.53% (Example 4). When the temperature of the esterification is increased as taught by **Braun**, the THF formation amounts to 3.89% which is at least by a factor of 1.54 higher than the THF formation in accordance with applicants' process. Correspondingly, under the conditions of applicants' process, 2,5-DHF<sup>6)</sup> is formed in amounts ranging from 0.009% (Example 5) to 0.018% (Example 4). When the temperature of the esterification is increased as taught by **Braune**, the 2,5-DHF formation amounts to 0.036% which is at least by a factor of 2 higher than the THF formation in accordance with applicants' process.

The teaching of **Braune** not only fails to suggest or imply that the temperature in the esterification reactor cascade does not increase, it also contains nothing which suggests or implies that the way in which the temperature is adapted in the esterification reactor cascade has an impact on the amount in which the unwanted by-products THF and 2,5-DHF are formed. A person of ordinary skill in the art could therefore not expect to arrive at a process which provides for a reduced formation of THF and 2,5-DHF by modifying the temperature in the esterification reactor cascade. The disclosure of **Braune**, therefore, cannot be taken to render applicants' process as a whole prima facie obvious within the meaning of 35 U.S.C. §103(a).

The foregoing is not only applicable where Claim 7 is concerned, but equally applies to the subject matter defined in Claims 1 to 6 and 8 to 11 since the requirement of applicants' process that the temperature along the esterification reactor cascade does not increase is set forth in Claim 1 and incorporated by reference in the dependent claims. If an independent claim is non-obvious under 35 U.S.C. §103, then any claim depending therefrom is non-obvious<sup>7)</sup>. Favorable reconsideration of the Examiner's position and withdrawal of the rejection under Section 103(a) is solicited.

In light of the foregoing and the attached, the application should therefore be in condition for allowance. Favorable action is solicited.

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5) Note the data on page 12, in row 3 of Table 1.

6) Note the data on page 12, in row 4 of Table 1.

7) In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (CAFC 1988).

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees, to Deposit Account No. 11.0345. Please credit any excess fees to such deposit account.

Respectfully submitted,

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Encl.: THE LISTING OF CLAIMS (Appendix I)  
THE AMENDED CLAIMS (Appendix II)

HBK/BAS

## A P P E N D I X I:

THE LISTING OF CLAIMS (version with markings):

1. (currently amended) A process for the continuous preparation of polybutylene terephthalate from terephthalic acid and 1,4-butanediol, comprising:
  - a) direct esterification of terephthalic acid with 1,4-butanediol in a reactor cascade comprising at least two reactors,
  - b) precondensation of the esterification product obtained in stage a), and
  - c) polycondensation of the precondensate obtained in stage b),wherein the reaction pressure decreases and the temperature does not [~~increases~~] increase along the reactor cascade in stage a).
2. (original) A process as claimed in claim 1, wherein the esterification in stage a) is carried out at pressures of < 1 bar.
3. (previously amended) A process as claimed in claim 1, wherein, in a reactor cascade comprising three reactors, the pressure in the first reactor (p1) is < 1 bar, the pressure in the second reactor (p2) is < p1 - 100 mbar and the pressure in the third reactor (p3) is < p2.
4. (currently amended) A process as claimed in claim 1, wherein the esterification stage a) is carried out at from 170 to 250°C.
5. (previously amended) A process as claimed in claim 1, wherein the molar ratio of 1,4-butanediol to terephthalic acid at the beginning of stage a) is from 1.1:1 to 3.5:1.
6. (previously amended) A process as claimed in claim 1, wherein the conversion after the last reactor of stage a) is > 97%, based on terephthalic acid, before the precondensation in stage b) commences.
7. (currently amended) A process as claimed in claim 1, wherein the direct esterification stage a) is carried out in the presence of a catalyst[~~, preferably tetrabutyl orthotitanate~~].
8. (currently amended) A process as claimed in claim 1, wherein the precondensation stage b) is carried out at temperatures from 220 to 300°C and pressures in the range from 0.05 bar to the esteri-

fication pressure in the last reactor of the reactor cascade of stage a).

9. (*previously amended*) A process as claimed in claim 1, wherein the precondensate obtained in stage b) is polycondensed in stage c) at from 240 to 290°C and pressures of from 0.2 to 20 mbar.
10. (*original*) A process as claimed in claim 9, wherein the polycondensation is continued until the polycondensate obtained has an acid number of < 50 meq/kg.
11. (*new*) The process of claim 7, wherein the catalyst is tetrabutyl orthotitanate.

## A P P E N D I X II:

THE AMENDED CLAIMS (clean version of all claims):

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1. (currently amended) A process for the continuous preparation of polybutylene terephthalate from terephthalic acid and 1,4-butanediol, comprising:
    - a) direct esterification of terephthalic acid with 1,4-butanediol in a reactor cascade comprising at least two reactors,
    - b) precondensation of the esterification product obtained in stage a), and
    - c) polycondensation of the precondensate obtained in stage b),wherein the reaction pressure decreases and the temperature does not increase along the reactor cascade in stage a).
  2. (original) A process as claimed in claim 1, wherein the esterification in stage a) is carried out at pressures of < 1 bar.
  3. (previously amended) A process as claimed in claim 1, wherein, in a reactor cascade comprising three reactors, the pressure in the first reactor (p1) is < 1 bar, the pressure in the second reactor (p2) is < p1 - 100 mbar and the pressure in the third reactor (p3) is < p2.
  4. (currently amended) A process as claimed in claim 1, wherein the esterification stage a) is carried out at from 170 to 250°C.
  5. (previously amended) A process as claimed in claim 1, wherein the molar ratio of 1,4-butanediol to terephthalic acid at the beginning of stage a) is from 1.1:1 to 3.5:1.
  6. (previously amended) A process as claimed in claim 1, wherein the conversion after the last reactor of stage a) is > 97%, based on terephthalic acid, before the precondensation in stage b) commences.
  7. (currently amended) A process as claimed in claim 1, wherein the direct esterification stage a) is carried out in the presence of a catalyst.
  8. (currently amended) A process as claimed in claim 1, wherein the precondensation stage b) is carried out at temperatures from 220 to 300°C and pressures in the range from 0.05 bar to the esteri-



fication pressure in the last reactor of the reactor cascade of stage a).

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cont
9. (previously amended) A process as claimed in claim 1, wherein the precondensate obtained in stage b) is polycondensed in stage c) at from 240 to 290°C and pressures of from 0.2 to 20 mbar.
  10. (original) A process as claimed in claim 9, wherein the polycondensation is continued until the polycondensate obtained has an acid number of < 50 meq/kg.
  11. (new) The process of claim 7, wherein the catalyst is tetrabutyl orthotitanate.
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